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Each branch of the United States Armed Services processes Foreign Military Sales (FMS) requisitions differently. Each service uses the Defense Automated Addressing Service (DAAS) to a different extent for this processing (that is, validating, forwarding and/or editing). This study compares the time of processing requisitions by each service by using a source of supply (Defense Electronic Supply Center) receipt date and the MILSTRIP submission date on FMS requisitions that passed through each service. An analysis of variance on the submission-time showed the Air Force to be significantly faster. Also an examination of the method employed by each service showed the Air Force uses DAAS the most.

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FOREIGN MILITARY SALES REQUISITION PROCESSING BY THE ARMED SERVICES

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Problem Statement

The Foreign Military Sales (FMS) program of the United States is managed by the Armed Services and other supply and service related agencies of the Department of Defense (DoD). The daily business transactions (requisitions, cancellations of requisitions, status reports, etc.) that result from the Armed Services FMS contracts for goods and services are controlled through the International Logistics Center/Office (ILC/ILO) of each of the branches of the Armed Services. Each branch of the service, then, determines its own procedures and policies for handling this daily business.

Thousands of FMS requisitions must be processed each day. The "processing" of FMS requisitions is the receipt of a materiel request from a foreign country by the receiving activity (this differs according to the branch of the service) via the Automated Digital Information Network (AUTODIN), Telecommunications Exchange (TELEX), message, or mail (this depends on the country's capability). The request is then edited to check certain validation criteria (specified by each service and the Military Standard Requisitioning and Issue Procedures [MILSTRIP]), and a search is conducted for

the source of supply for the item/items requested. The request is then mailed/transmitted to that source of supply. The different methods employed by each service to accomplish this task will be examined later in this study.

The Defense Automatic Addressing System (DAAS) is an automatic data processing (ADP) center which exists to process and mail these requisitions as a service for the Army, Navy, Air Force, Marines, Coast Guard, and all other federal agencies. This center has, among various capabilities, that of validating and editing requisitions, and obtaining the most current source of supply for materiel requested. It also has the capability to transmit or mail (in bulk) the requisitions to their proper destination. The degree to which DAAS is utilized depends upon the procedures and policies of the using organization. For example, certain military activities do not utilize DAAS at all, and others request DAAS to accomplish as many functions as possible for them. These functions may range from editing transactions to creating images of transactions to accumulating transactions to be used to generate statistical reports.

Preliminary investigation has revealed that the Air Force requires DAAS to validate the source of supply in a requisition before it is forwarded to the Air Force Logistics Command (AFLC) ILC in order to insure that it is

currently correct. On the other hand, the Navy, for instance, does not require that DAAS accomplish this validation. The Navy International Logistics Control Office (NAVILCO), upon receipt of the requisition, interrogates the DAAS files to ascertain the source of supply. The Army has a procedure similar to the Navy. The United States Army Security Assistance Center (USASAC) requests certain edits be accomplished by DAAS and does some of the edits itself. The lack of standardization in this area is often a source of confusion for the foreign governments, each of which may deal with all branches of the Armed Services at one time (1:25). Also, another source of confusion resulting from the different methods used by the services is the time involved in processing the requisition.

This study examines in more detail the extent to which DAAS is utilized by the Army, Navy, and Air Force and the time involved in each service's method of requisition processing. Extent is to be defined as the number of different functions such as editing, validating, transmitting, mailing, etc., accomplished by DAAS for a particular requisition for a particular service. The time interval to be investigated is the time from requisition transmission by the foreign country to receipt by a source of supply.

Background

FMS

FMS is a program that was implemented by the United States to aid foreign governments through the sale of goods and related services for tactical weapons systems (14:17). One goal of the program is to develop allies with the capability to aid the United States in a combat crisis. This concept is referred to in the Total Force Concept (6:1-2). Another goal is to enable certain foreign countries to become more economically and technologically independent.

Guidance on FMS history and goals exists in the legislative process, specifically the Foreign Assistance Act of 1961 and the Arms Export Control Act of 1968. The acts specify the reasons for the FMS program.

> It is the policy of the U.S. to facilitate the common defense by entering into international arrangements which further the cooperative exchange of data, research, development, production, procurement, and logistics support [14:176].

Directing attention to the Defense Department,

> . . . the Secretary of Defense shall have primary responsibility for . . . procurement of military equipment in a manner which permits its integration with services programs; establishment of priorities in the procurement, delivery, and allocation of military equipment [14:10].

Selling to foreign governments has resulted in many areas of concern. One particular area has been the confusion and misunderstanding on the part of the foreign

country which may be due to lack of standardization among the agencies of the Armed Services. Since its inception, the FMS program has grown considerably, and during this time each service has developed its own procedures for handling FMS requisitions. The Air Force Regulation 40-3 (5:32), the Army Regulation 725-50 (7:135), and the Naval Supplement-526 (13:37) outline the procedures of each respective service. Also the MILSTRIP Manual 4140.17 dictates the common end result format that the services must use. These differing procedures are confusing to those involved in administering the program.

The foreign governments must deal with many different agencies when procuring supplies and services since different supplies and services are managed by different agencies. This requirement and the resulting confusion is noted by Lieutenant Colonel Thomas C. Collipi. Service management practices and procedures in the FMS area are analyzed in Collipi's thesis and the following recommendations resulted:

> (1) Formation of a joint FMS management standardization board to supervise and maintain configuration control of the DoD FMS Administrative system. (2) Assignment of single manager responsibilities to each of the services for standardizing specific areas of the FMS management system [1:82].

Standardization

Attempts have been made in the past to standardize many aspects of the logistics process.

JLC. In order to aid the standardization of processes within the Armed Services, the Joint Logistics Command (JLC) was created. The purpose of the JLC is to resolve problems existing in the DoD through a joint effort of the services. Through these joint efforts, simplification and standardization of the different procedures used by the military should be accomplished. This panel, consisting of the commanders of AFLC, Air Force Systems Command (AFSC), the Army Development and Readiness Command (DARCOM), and the Navy Materiel Command (NMC), has as its two acquisition/logistics purposes:

> 1. Prevent duplication by joint utilization of personnel, intelligence, facilities, equipment, supplies, and services in all cases where military effectiveness and economy of resources will thereby be increased.
> 2. Conform to uniform policies and standardize on materiel and logistics concepts, systems design, forms terminology and criteria for the procurement, requisition, storage, transportation, distribution, issue, and maintenance of weapons systems, supplies, and equipment consistent with the specialized needs essential to the effective functioning of each Command [11:1-1-12].

Thus, standardization is clearly an aim of the logistics plan of the Armed Services and the FMS panel of the JLC.

MILSTRIP. Another attempt to standardize requisitioning among the Armed Services is MILSTRIP. MILSTRIP is functionally defined as a system which:

> . . . prescribes uniform procedures, data elements and codes, formats, documents and time standards for the interchange of logistics information relating to

> requisitioning, supply advice, supply status, materiel issue, materiel receipt, and materiel return process [8:15].

The MILSTRIP provisions were developed under the authority of DoD Directive 4000.25 (8:1). DoDD 4000.25 "prescribes uniform guidance and responsibilities for the assignment, development, and continuous administration of the Military Standard Logistics Systems (MILS) [8:1]." The purpose is to "attain a greater degree of simplification, standardization, and automation in the logistics functional areas [8:1]." FMS requisition processing also employs MILSTRIP and thus the desire for standardization is even more evident.

DAAS. DAAS was conceptually defined as a method for the automatic addressing of logistic traffic within AUTODIN (9:1). The history of the origination of DAAS exists in a handbook written by the Chief of DAAS in 1965. DAAS was originally a task force of the Military Data Element Standardization and Management Office (MILDESMO) assigned, in 1964, to investigate the possibility of centralizing the function of processing MILSTRIP documents and addressing them to the proper destination (9:3). The task force's findings were favorable toward centralization and in 1965 a prototype organization was established and later reviewed. The end result was to create an organization, DAAS, in 1966, to accomplish the task of processing

and addressing MILSTRIP documents and several types of management reports (Logistics Information Data Service [LIDS]) with which this study is not concerned. The Army, Navy, and Air Force individually began evaluating the utilization of DAAS. Each service decided to use DAAS to a different extent in the preparation and processing of its supply requisition documents. While MILSTRIP dictates a standard document and end result format, it does not specify the method by which this must be accomplished/prepared. Therefore, each service centralized only those functions that would benefit its present operation. "DAAS receives, processes, and forwards designated documents, as authorized by the Military Service/Agency Document Matrix [10:1]." DoDD 4000.25 set forth the current responsibilities of DAAS and these are supplemented in DoD 4140.29-M. The purpose of DAAS is to integrate the automation of DoD logistics processing with a direct linkage to the AUTODIN network. Today DAAS not only processes logistic traffic, but also maintains a data base file and historical files, and generates reports as requested by the services.

The Time Dimension

The speed with which a FMS requisition arrives at the correct source of supply is a concern not only to the foreign country itself but also to the United States. The faster the requisition arrives at the source of supply, the

faster it will be filled. Even in the case of back orders or notification of the "nonexistence" of the item, the entire process of logistics, getting the right item to the right place in the right amount at the right time (as soon as possible), is expedited by each step being expedited. The requisition process is the first step, or the input to the supply support system.

The foreign country is concerned with the speed of supply support for its own readiness and, subsequently, national security. Likewise, the United States is concerned with the readiness of its allies since, in the time of threat to the United States, it often must rely on its allies' military support for an intermediate time period or perhaps for the duration of the threat. Therefore, the perpetual readiness of allies is important and is partially reliant upon the input to the supply support system, requisition processing.

The countries that were eventually selected for this study include four that use AUTODIN for the majority of their requisitions and one (Turkey) which uses mail and one (Taiwan) that uses dataphone. The countries were chosen for volume of requisitions and not by means of transmission. The means that a country employs to transmit requisitions is used with all three services.

Research Objective

In maintaining its own particular needs in the sphere of FMS with the United States, a foreign country must deal with all three branches of the United States Armed Services in requisitioning materiel. The ability of the countries involved to understand and utilize the FMS requisition processing system would be increased through standardization. Also, it has been noted previously that DAAS is used by differing degrees in the processing of requisitions for the services. It would seem that by centralizing certain tasks in the processing of requisitions for the three services through DAAS under a standard procedure, a savings in costs and time may be realized. The processing of requisitions for the FMS program would, therefore, be enhanced by the three branches of the Armed Services using the same policies and procedures.

There are many different types of transactions which are used to maintain the FMS programs. These range from the initial requisition to modifications to that requisition to status on that same requisition. However, since the requisition itself is the initializing force in the logistics cycle, the scope of this study will be limited to the processing of FMS requisitions by the Army, Navy, and Air Force. The use and/or non-use of DAAS will be an integral part of the study effort.

Since, as previously mentioned, the requisition is the initializing transaction from which all others develop, the time period to be investigated is the time interval occurring from the initial preparation and transmission of the requisition by the foreign country to the receipt of the requisition by the correct source of supply stocking the materiel (submission time). The time frame involved in filling a requisition after receipt at the correct source of supply is not dependent on the method used by the service to forward the requisition to that source of supply.

The purpose of this research effort is to investigate the current methods of processing FMS requisitions used by each service, and to quantify the differences in time of each method.

Research Hypothesis

The problems expressed in the preceding pages have directed this research effort toward the following hypothesis:

(1) The time interval (from the initial preparation and transmission to receipt at a source of supply) involved in processing FMS requisitons differs, statistically significantly, among the Army, Navy, and Air Force. Furthermore, this difference exists at a 5 percent significance

level as evidenced by review of the mean submission time of FMS requisitions.

(2) The mean submission time for FMS requisitions processed by the Air Force is significantly less than the mean submission time for FMS requisitions processed by the Army or Navy.

CHAPTER II

FMS REQUISITION PROCESSING

Classification of Requisition Documents

Submission time of a requisition extends from the date of submission to the date of receipt by the initial wholesale supply source. The date of requisition (submission) indicates the actual date of transmittal from the requisitioner to the ILC/ILO. Errors in the requisition date are amended to reflect the true date of transmittal. Time consumed by review of the ILC/ILOs of each respective service which is intermediary between the requisitioner and the source of supply is counted in the time measurement of this segment (12:2-6). This is the date that was examined for the data provided by the Defense Electronic Supply Center (DESC) in this study. The data represented requisitions from all countries that have FMS cases through the Army, Navy, and Air Force (Appendix A).

Requisitions are the MILSTRIP documents that were examined in this analysis. There are, however, several classifications of requisitions outlined in MILSTRIP. Each requisition's classification appears as part of the Document Identifier Code (DIC).

> The [DICs] provide a means of identifying a given product (i.e., requisition, referral action, status card, follow up, cancellation) to the system to which it pertains and further identifies such data as to its intended purpose and usage and the operation dictated. The [DIC] enables ADP equipment to select the appropriate program(s) and to mechanically perform operations dictated by the code and provides a corollary function for manual operations [12:B1-1].

The DICs that concern FMS range from codes A0 to A6, except there is no A1. There is further classification within each code denoting the part number, stock number, and type of shipment.

Requisitions with a DIC denoted by A0 (except A05) are those that are sent via electronic means from the foreign country to the receiver (ILO/ILC or DAAS) and to which there are no special remarks requiring an attachment. The A05 is for that purpose and is sent via mail (12:B1-2). The DICs of A0 make up the bulk of this study.

DICs denoted by A2 are Redistribution Orders. These are not truly requisitions but rather represent a transaction originated by an item manager to direct release from a source of supply to another source of supply within the same distribution activity (12:3-9). Since these transactions may concern foreign country requisitions but do not actually represent requisitions from foreign countries and generally only concern intraservice movement of item management, we are not concerned with A2 DICs in this study.

A3 denotes DICs that are Passing Orders, and A4 denotes DICs that are Referral Orders. Passing or Referral Orders are requisitions that are passed or referred by one source of supply to another source of supply for continued supply action (12:3-7). The A3s and A4s from foreign countries are recorded in the statistics of this study.

DICs denoted by A5 are Materiel Release Orders which are used as directives for release and shipment of materiel from stock. They are prepared by the source of supply "as a result of processing requisitions against inventory records and determination that materiel is available [12:3-6]." DICs denoted by A6 are denials of Materiel Release Orders and are sent to the source of supply by the storage site (12:3-7). Neither A5 nor A6 DICs represent a requisition initiated by a foreign country and are not included in this study.

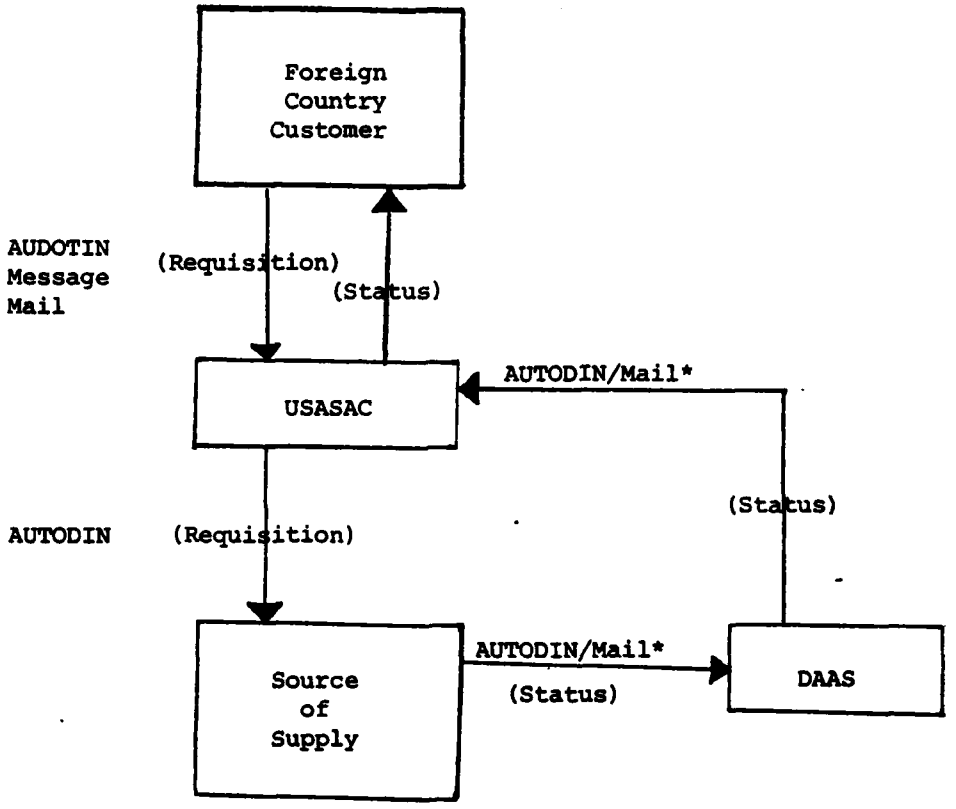
Army

The Army International Logistics Office at USASAC in New Cumberland, Pennsylvania receives requisitions from foreign country customers via AUTODIN/TELEX, message and mail. All requisitions received by message or mail are routed to an operations branch for processing onto punched cards. The cards as well as the requisitions received via AUTODIN are edited in the Army's International Logistics

computer system, Central Integrated System, International Logistics (CISIL). The edit programs check that the National Stock Number (NSN) is all numeric, that the source of supply specified is correct, that the Army is actually the manager for the requested item, and that the FMS case is active and has funds to cover the purchase.

If the requisition passes through the CISIL edits, it is sent on to the source of supply. This flow is depicted in Figure 1. Figure 1 also shows the remaining steps in the process of requisitioning which includes the status being sent by the source of supply through DAAS to USASAC and the customer. The Army uses DAAS for forwarding the status only.

Requisitions processed by the Army, Navy, and Air Force can differ in the speed with which they reach the source of supply for two reasons other than just the method the particular service uses. The first is priority assignment. Priorities can be assigned from 1-15. The priorities are based on several different prerequisites including the Force Activity Designator (FAD) and the Uniform Materiel Movement Issue Priority System (UMMIPS). These priorities are not made at the discretion of the services and since the procedures for handling the different priorities is specified in MILSTRIP, the services have little control over this time element.



*Incorrect requisitions are returned via mail.

Fig. 1. Requisition Flow--Army (2:7)

The other element that may cause a delay is any problem with the requisition. Generally these problems arise due to errors that the submitting country may make in preparing the requisition. These include an incorrect NSN or source of supply. Also a foreign country customer could send requisitions to the wrong item manager. The time spent to correct these problems may be inherent in each service's method. The Army can correct NSNs and the source of supply, but for an incorrect item manager, the Defense Logistics Services Center in Battle Creek, Michigan is contacted to ascertain the correct manager. This information and the requisition is then sent back to the customer for resubmittal.

Navy

NAVILCO, in Philadelphia, Pennsylvania, also receives requisitions by AUTODIN/TELEX, message and mail from foreign country customers. Initial edits on requests that are sent via AUTODIN are performed by the Naval computer system, Management Information System for International Logistics (MISIL), to determine if the case is active and if funds are available. Unlike the Army, however, the Navy then goes to DAAS for transmission of the requisitions to the correct source of supply. This process is depicted in Figure 2. Also depicted is the mail and

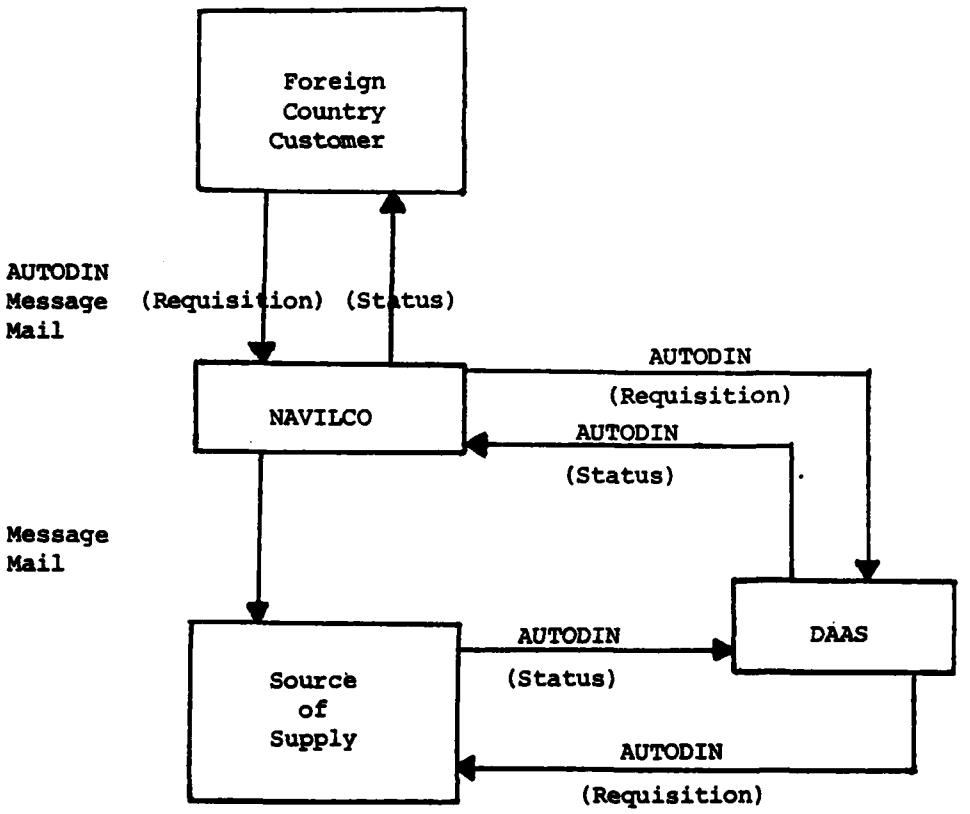


Fig. 2. Requisition Flow--Navy (2:8)

message type requisitions which are sent by mail or teletype to the source of supply unless they are easily put into card format, in which case they are transmitted via AUTODIN. The source of supply goes back through DAAS with notification of status which is sent through NAVILCO to the foreign country customer. The Navy handles incorrectly prepared requisitions in a manner similar to that of the Army. Those that have incorrect NSNs or source of supply are corrected by NAVILCO. NAVILCO also attempts to send incorrectly sent requisitions to the proper item manager.

Air Force

Requisitions from foreign country customers for Air Force items are sent either directly to DAAS via AUTODIN or to the AFLC/ILC at Wright Patterson Air Force Base, Ohio via AUTODIN/TELEX, message and mail. If DAAS receives the requisition first, it performs a NSN edit and a source of supply edit. Next, the requisition is sent through the Air Force computer system, HO51, for fund citation and then is sent back to DAAS. After all the requisitions received by the ILC directly from the foreign country customer have fund citations applied, they are sent to DAAS via AUTODIN, also. The requisition is then forwarded to the source of supply. Status of the requisition is sent to DAAS by the source of supply which in turn sends the status to the ILC

and to the foreign country customer. This flow is shown in Figure 3.

Errors pertaining to the NSN that may have occurred in the preparation of the requisition are handled manually by the ILC, while errors in source of supply are corrected by DAAS. The Air Force will forward to the correct item manager any requisition that was sent to the wrong service item manager.

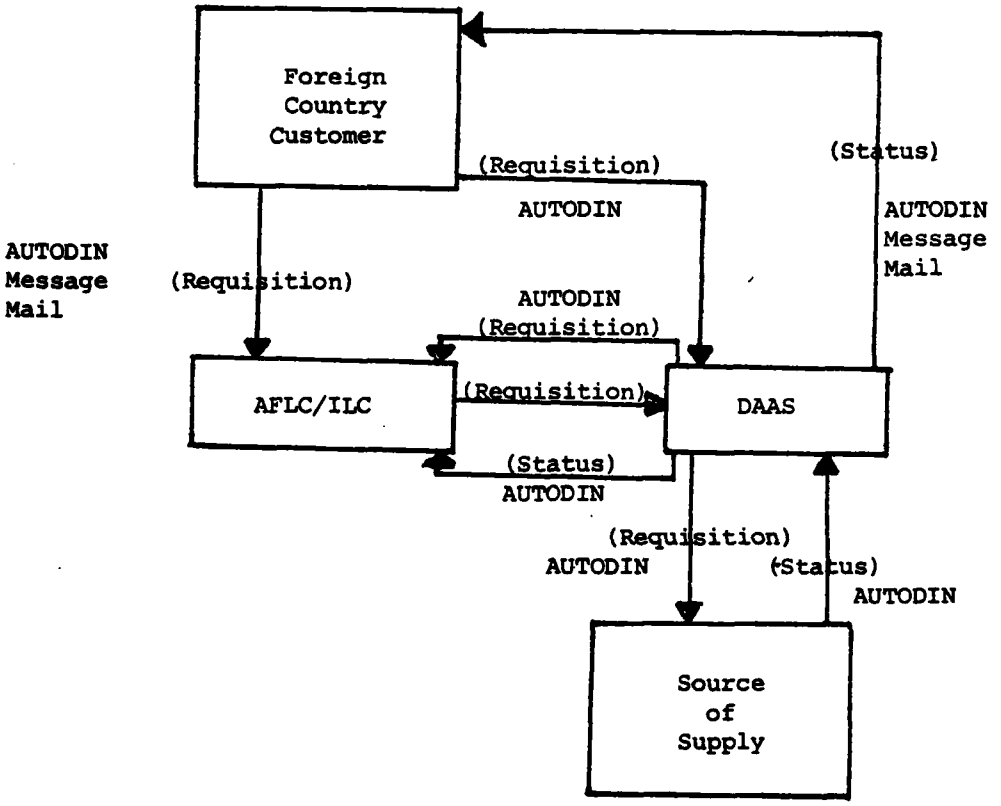


Fig. 3. Requisition Flow--Air Force (2:9)

CHAPTER III

RESEARCH METHODOLOGY

Overview

The purpose of this chapter is to explain the procedures used to collect the data and obtain a sample from that data which was used in determining the average time involved in processing a FMS requisition by each of the services and in determining if there were significant differences in these times.

Data Collection Plan

A Defense Logistics Agency (DLA) activity, which is the DLA source of supply of electronic parts for the services, was used for the source of data. All FMS requisitions received at DESC for a 180-day period were used as the population from which the samples were drawn. Choosing DESC as the source of supply limited this study to requests received by a DLA source of supply, in contrast to service sources of supply, and also limited the requisitions to those for electronic parts. However, the purpose of the study was to determine average time involved from the initial preparation to receipt by the source of supply of a requisition. The actions taken after a requisition has reached the source of supply were not considered in this

study. Therefore, it was assumed that the choice of one particular source of supply should not have an effect on the results.

The unit of observation for this study was a FMS requisition entered into one of the services' supply systems as an eighty-character document. The time span which was used to determine the average time occurring from initial preparation of the requisition to receipt by the source of supply was obtained from two dates entered in the document. These were the date of requisition and date of receipt. As is required by MILSTRIP, the date of requisition is entered by the initiator in card columns (CC) 36-39 in the format, YDDD, where Y is the last position of the year and DDD is the Julian date. The date of receipt used was the date inserted by DAAS when it intercepted the requisitions for DESC. Since DAAS and DESC are physically co-located, DAAS intercepts AUTODIN traffic addressed to DESC onto tape which is then input into the DESC requisition processing system. The format for this field is DDD, the Julian date. Computation of the time interval from initial preparation to receipt (submission time) was, therefore, accomplished by finding the difference between these Julian dates.

Sampling Plan

To determine the submission time, a sampling of each service's requisitions was made. The universe of interest

included all documents handled by USASAC, NAVILCO, and AFLC/ILC. The population of particular interest was the requisitions for sales to foreign countries. A census of the data would have been physically impractical since it would have entailed full time review of requisitions at each of the above agencies. Therefore, a restricted probability sampling plan was used. After obtaining the data from DESC, the population of FMS requisitions were grouped together by service and by country. This was necessary in order to study the requisitions of the population subgroups, the Army, Navy, and Air Force. Then, a computer program was developed, Appendix B, in which a simple random sampling procedure was used to draw equal samples of the requisitions submitted by service and by country. Determination of the sample size will be addressed in the following discussion on the research design.

Design to Test Research Hypothesis

To test the research hypothesis, it was first necessary to formulate a statistical hypothesis to test. This hypothesis is that the mean time for the Army, Navy, and Air Force to process a requisition does not differ significantly ($\mu_1 = \mu_2 = \mu_3$, where μ_1, μ_2, and μ_3 are the mean times for the Army, Navy, and Air Force, respectively). This was tested by an analysis of variance (ANOVA) model.

ANOVA is used for studying the statistical relation between a dependent variable and one or more independent variables. A randomized complete block design (3:14) was chosen as the experimental design. The treatment factor, or independent variable, under study was the particular service processing procedure. The block was the foreign country submitting the requisition. The dependent variable was the time from the initial preparation to receipt by the source of supply of the requisition, or submission time.

Formally, the design for testing the treatment factor effect was as follows:

1. Null hypothesis:

   H_0: There is no difference in the mean submission time of processing a FMS requisition among the services; i.e., $\mu_1 = \mu_2 = \mu_3$.

   H_A: There is a difference in the mean submission time of processing a FMS requisition among the services; i.e., not all μ_is are equal.

2. Statistical test:

$$F^* = \frac{MSTR}{MSE} = \frac{\text{mean square of treatment factor}}{\text{mean square error}}$$

3. Decision rule:

   If $F^* \leq F$ (95%; a-1, (b-1)(a-1)), conclude H_0.

   If $F^* > F$ (95%; a-1, (b-1)(a-1)), conclude H_A.

(where a = 3, 3 treatment factor levels;

b = 6, 6 blocks; and

n = number of observations associated with each ab cells) (4:727-728).

Eight countries were initially chosen as the blocks. These eight countries with the three services, resulted in a twenty-four cell matrix, depicted in Appendix C. These countries were Australia, Canada, Germany, South Korea, Spain, Saudi Arabia, Turkey, and Taiwan. These countries were those with the greatest requisition activity indicated when the DESC data was grouped by country and by service. Next, it was necessary to determine the sample size required for the study. It was desired to have a sample size large enough so that if the null hypothesis was indeed rejected, conclusions could then be drawn from the data concerning which of the cell means were significantly different from the others. Fisher's Least Significant Difference (LSD) statistic (3:87):

$$LSD = t_{\alpha/2,\ \nu} \sqrt{\frac{2\hat{s}^2}{n}} \qquad (1)$$

where

$\hat{s}^2$ = estimate of within cell variance

n = number of observations per cell

ν = number of cells minus one

provided a method of estimating the required sample size. Given $\hat{s}^2$, n, and ν at a certain alpha level, the LSD statistic provides a limit for determining significantly different treatments. Any treatments resulting in cell means which differ by an amount greater than this limit are significantly different. Solving equation 1 for n gives:

$$n = \frac{(t_{\alpha/2,\nu})^2 2\hat{s}^2}{(LSD)^2} \qquad (2)$$

The t statistic for an alpha level of .05 with twenty-three degrees of freedom is 2.069. Preliminary investigation, prior to obtaining the data from DESC, had indicated that the variance of forty-four days would be reasonable. Also, since FMS requisition processing is of major importance in conducting business with foreign countries, an LSD of one day was set as the level of managerial significance. Based on these estimates, the necessary sample size, using Equation 2, was found to be 377. There was sufficient data to obtain the samples from each cell using the eight countries chosen. However, once the data was obtained, further examination found that the actual variances were much greater than forty-four days. Using the actual data, variances were computed for the twenty-four cells and it was found that a sample size of 456 observations would be sufficient. As a result, it was decided to omit Canada as a block since there

were insufficient observations from which to sample for Canada. Also, this examination of the actual data resulted in the finding that the variance for Saudi Arabia was unreasonably large. It was felt that this variance may have been due to unusual conditions relating to current events occurring in the foreign policy arena. Consequently, it was decided to omit Saudi Arabia, also, to eliminate these external effects on the conclusions that would be drawn. Summarizing, the randomized complete block experimental design for the ANOVA resulted in eighteen cells, each having 456 observations (Appendix D).

The assumptions of independence required by ANOVA was met by the random selection of the 456 observations for each cell. ANOVA also requires the assumptions that the probability distributions of the dependent variable are normal, and that they have constant variance. In regard to the normality assumption, studies by Pearson and Norton (3:61) have shown that a moderate departure from normality has little effect on the test of significance in ANOVA. In regard to the homogeneity of variance assumption, Kirk states,

> The F distribution is robust with respect to violation of the assumption of homogeneity of population--error variances provided that the number of observations in the samples is equal (Cochran, 1947; Norton as cited by Lindquist, 1953) [3:61].

As a result, it was felt that these assumptions were satisfied. However, it was decided to use the Cochran's "C" procedure provided by the Statistical Package for the Social Sciences (SPSS) to test for homogeneity of variance since inspection of the data resulted in finding larger variances than the researchers had initially expected. The cell variances and this test will be addressed in Chapter IV.

There are two steps involved when using the ANOVA technique. In the first step, the value of the F statistic determines whether or not there is a significant difference among the factor levels, according to the decision rule. If there is no difference, the null hypothesis is accepted and the study is concluded. If, however, the F statistic shows a difference among cell means, further analysis is usually accomplished to determine what these differences are. For this study, Duncan's Multiple Range Test was chosen to accomplish this second step (3:93).

CHAPTER IV

RESULTS AND FINDINGS

Introduction

In this chapter the results of the ANOVA and the subsequent Duncan's Multiple Range Test are discussed. Transformation of the sampled data are also addressed.

The data received from DESC was processed and the submission time was computed for each observation using the computer program found in Appendix E. Statistical subprograms available in the SPSS package were then used for the analysis of the submission times. These were ANOVA, multiple classification analysis (MCA), and ONEWAY (Appendix F).

Results of ANOVA

The eighteen cell variances, output from ONEWAY, are shown in Appendix G. It was found using the Cochran's "C" test statistic that the variances were not homogeneous. It is recommended by certain statisticians (3:63) to perform one of several types of transformations on data with heterogeneous variances to achieve homogeneity. This was done using the following four recommended transformations (X = submission time and X^1 = transformed submission time):

$$X^1 = \sqrt{X} \qquad X^1 = \sqrt{X} + \sqrt{X+1}$$

$$X^1 = \log_{10}(X+1) \qquad X^1 + \frac{1}{X+1}$$

The cell variances resulting from the transformation and Cochran's "C" test statistic are shown in Appendix H. Cochran's "C" test statistic indicated heterogeneity of variance in the transformed data, as well. It was decided to accomplish the following analysis based on the original data, ignoring the transformed data, for three reasons. These are that (1) some researchers claim that the analysis of transformed data cannot be extended to the original data (3:67), (2) the F distribution, used in ANOVA, is relatively unaffected by the heterogeneity of variance, and (3) ANOVA is regarded as approximate, rather than exact (3:60).

Results of the ANOVA subprogram are found in Appendix I. The F statistic at the service level, 1229.262, is significant. Therefore, the null hypothesis that the mean submission times of the services are equal must be rejected.

Additional Findings

The ANOVA results, however, do not provide any indication of the proportion of variation in submission time that is due to the service factor. It also provides no indication of the lengths of the submission times. The MCA provides both of these.

The results of the MCA are found in Appendix J. The overall grand mean was 24.38 days. The proportion of variation in the submission time explained by the "service" factor was 19.36 percent ($[.44]^2$) while the "country" block explained 12.25 percent ($[.35]^2$). The proportion of variation due to interaction may be computed using the equation:

$$\omega^2 = \frac{SS_{AB} - (p-1)(q-1)MS_{RES}}{SS_{TOTAL} + MS_{RES}} \quad (3:198) \quad (3)$$

where:

SS_{AB} = 2-way interaction sum of squares

p = number treatment factors

q = number blocks

MS_{RES} = residual mean square

SS_{TOTAL} = total sum of squares

This proportion was 2.98 percent. Considering the sum of these percentages (34.59), there remains 65.41 percent of the variation due to error and random effects not considered in the design. Therefore, the proportion of variance due to the particular service processing procedures should be kept in mind when reading the conclusions drawn and implications made in the following chapter. An important output from the MCA is the unadjusted deviation. Using these deviations for each service and the grand mean, the average

submission times for Army, Air, and Navy requisitions are 35.5, 11.02, and 26.62 days, respectively. The deviations are also given for the countries, or blocks, from which the average submission time for a certain country could be computed.

Since the F statistic from the ANOVA indicated that there was a significant difference among the mean submission times, but it did not indicate where the difference(s) were, the ONEWAY subprogram with the Duncan's Multiple Range Test option was employed. The first step in this procedure is to rank the cells in order of their mean size. The next step is to perform pairwise comparisons among all the cell means. Cells whose means are not significantly different are then grouped into subsets. The results of this test are found in Appendix K. Each subset is significantly different from the others. The eighteen cells and mean submission time for each cell are found in Table 1. In Table 2 the cells whose means are not significantly different are enclosed by brackets. The mean submission times for the Air Force, Army, and Navy for the six countries range from 5.4452 to 18.4364, 20.2939 to 45.3399, and 8.4539 to 45.1886 days, respectively. These results illustrate that the requisition processing time of the Air Force is significantly less than that of the other two services.

TABLE 1

MEAN SUBMISSION TIME FOR FMS REQUISITIONS (IN DAYS)

Country of Submission	Branch of Service to Which the Requisition was Submitted: Army	Navy	Air Force	All Services
Australia	35.9	28.4	8.9	24.4
Germany	35.2	20.3	12.3	22.6
South Korea	34.3	18.6	5.4	19.4
Spain	20.3	8.5	5.9	11.6
Taiwan	45.3	38.8	18.4	34.2
Turkey	42.0	45.2	15.2	34.1
All Countries	35.5	26.6	11.0	
				Grand Mean = 24.4

NOTE: Each cell mean based on a random sample size of 456.

TABLE 2

STATISTICAL SIGNIFICANCE OF DIFFERENCES
BETWEEN CELL MEANS

Country of Submission	Branch of Service to which Requisition was Submitted	Mean Submission Time	Significance Relationships*
Taiwan	Army	45.3	]
Turkey	Navy	45.2	]
Turkey	Army	42.0	]
Taiwan	Navy	38.8	]
Australia	Army	35.9	]
Germany	Army	35.2	]
South Korea	Army	34.3	]
Australia	Navy	28.4	-
Spain	Army	20.3	]
Germany	Navy	20.3	]
South Korea	Navy	18.6	]
Taiwan	Air Force	18.4	]
Turkey	Air Force	15.2	]
Germany	Air Force	12.3	]
Australia	Air Force	8.9	]
Spain	Navy	8.5	]
Spain	Air Force	5.9	]
South Korea	Air Force	5.4	]

*Mean submission times grouped within a bracket have been determined by Duncan's Multiple Range Test not to differ significantly at a significance level of 99 percent.

The large and non-uniform variances (Appendix G) discovered in the course of this study added another dimension to the findings. There was no apparent reason discovered that might make some requisitions take as long as thirty days over the average time. The reason may be political or social, but for each country it was believed to exist across the services.

CHAPTER V

SUMMARY AND CONCLUSIONS

Review of Results and Findings

The six countries with the most requisitions going through the Army, Navy, and Air Force to DESC for a 180-day period were analyzed to determine any difference in the submission time due to the service which processed the requisition. The ANOVA performed on the means of eighteen cells each with 456 observations resulted in a significant difference. Further analysis, with transformed data and actual data, included Duncan's Multiple Range Test, and Cochran's Test and showed the Air Force overall mean was the reason for the significant difference. It was significantly less than the means of the Army and Navy.

Another finding as a result of the above analysis was the high variability of the different services. The Army requisitions, especially, exhibited high variability while the Air Force exhibited the least variance (Appendix G). This fact necessitated investigation of the transformation of data which resulted in the same findings (Appendix H).

Implications

In order to discuss the implications, it is necessary to reiterate the application or external validity of this study. While DESC was the only source of supply that furnished data, the results of this study are seemingly applicable to any source of supply within the DoD. This is true since all foreign countries and sources of supply must adhere to the rules specified in MILSTRIP. Also since five of the countries involved in the study use electronic means for transmitting the majority of their requisitions, DESC would observe the same transmission time as any source of supply regardless of location.

The implications of these two findings actually fall into three areas. First, the Air Force, having a significantly smaller overall mean requisition processing time for the same countries that the other services process requisitions for, would seem to have a better (in terms of the time dimension) method of processing requisitions. The Army and Navy, with significantly slower systems should perhaps note the speed of the Air Force system.

The second implication results from the difference in variability of the services' FMS requisition processing time. The high variability of the Army and Navy may indicate some problems in the reliability of their systems. The

Air Force system, however, exhibits more consistent time frames. This is important to the submitting countries for their logistical planning. They want to be able to rely on receiving supplies when they need them and high variability in the requisitioning pipeline may interfere with critical planning.

The third implication also results from the findings relating to the smaller mean processing time of Air Force FMS requisitions and the lower variability of that processing. The fact that the Air Force is faster and more reliable, coupled with the fact that the Air Force utilizes the functions of DAAS to a greater degree, implies that DAAS is the reason for the Air Force's efficiency. Perhaps the Air Force has less duplication of effort on the editing, validating, addressing and forwarding of requisitions by relying on DAAS for all these functions. The Army and Navy, on the other hand, accomplish these tasks themselves and send requisitions through DAAS as a formality, to meet the specifications of MILSTRIP. The Army and Navy might increase the speed of their systems by relying on DAAS for more processing steps. The Air Force, too, could conceivably improve processing time by allowing DAAS to accomplish more steps.

Managerial Perspective

As already mentioned, the importance of reliability of a system and speed of that system are essential in the logistical planning of United States allies and consequently to the logistical planning of the United States. These two concepts are very crucial and another aspect that is also important to the management of requisitioning is standardization.

United States allies must communicate through each branch of service of the United States for supply support. In essence, this means that each branch of service in the allied country must learn the requisition method of each branch of service in the United States, since different items that may be needed by the foreign military service are managed by different branches of the United States military service. A standardized method used by the Army, Navy, and Air Force would seemingly aid management by simplifying communication concerning requisitioning. The methods originally chosen by each of the services was done so incrementally and with effectiveness and convenience as objectives. FMS regulations dictated the necessity of checking available funding for foreign country requisitions and the individual services developed their systems accordingly. The original planning obviously did not consider the impact on the foreign countries due to the different

services' methods. Now, however, perhaps the situation should be examined and a plan developed considering the foreign countries' perspective.

Suggestions for Future Research

While we believe this study to be valid for all DoD sources of supply, it is still limited in scope to the time dimension. A study concerning the cost in dollars and man-hours for each system would be valuable. A study of this sort would require the cooperation of all three branches of the service; this may make the effort extremely difficult. The insight provided however, may make it possible for one system to actually be recommended to the Joint Logistics Command if the results were similar to the results in this study. The cost study could also include the cost of duplication of effort, either by DAAS or the services.

APPENDICES

APPENDIX A

COUNTRIES WITH FMS CASES

NAME
Afghanistan
Algeria
Andorra
Argentina
Australia
Austria
OAS Hq.
SHAPE
Bahrain
Barbados
Botswana
Belgium
Bahamas
Guyana
Bolivia
Burma
Brazil
Bhutan
Brunei
Burundi
Kymer Republic
Chad
Sri Lanka (Ceylon)
Congo (Brazza.)
Chile
Cameroon
Canada
Colombia
Costa Rica
Central African Rep.
Cuba
Zaire (formerly Congo Kinshasa)

NAME
Cyprus
ICC (Laos)
Dahomey
Denmark
Dominican Rep.
MAP ICP (USALDJ)
Ecuador
Egypt
Ireland
Equatorial Guinea
El Salvador
Ethiopia
Finland
France
Gambia
Gabon
Ghana
Greece
Guatemala
Guinea
Germany (Bonn)
Hellenic Aerospace Industries (HAI)
Haiti
Honduras
Indochina
Indonesia
Iceland
India
Iraq
Israel
Italy
Ivory Coast
Japan

NAME	NAME
Jamaica	Panama
Jordan	Portugal
Kenya	Qatar
Korea (Seoul)	Mali
Kuwait	Rwanda
NATO-WPP	Europe Region
NAMSA-F104	Near East/South Asia Region
Laos	East Asia/Pacific Region
Lebanon	American Republics Region
Liberia	Africa Region
Liechtenstein	Saudi Arabian National Guard
Lesotho	Senegal
Luxembourg	Sierra Leone
Libya	San Marino
Malagasy Rep.	Singapore
Malaysia	Somalia
Malawia	Spain
Monaco	Saudi Arabia
Morocco	Sudan
Mauritius	Sweden
Mauritania	Syria
Malta	Switzerland
Oman	United Arab Emirates
Maldive Islands	Trinidad - Tobago
Mexico	Thailand
MAPSAD	Turkey
MAPOM	Togo
F104G Depot	Tonga
Netherlands	Tunisia
Nigeria	China (Taipei)
Niger	Tanzania
Norway	CENTO Hq.
Nepal	SEATO Hq.
Nicaraqua	ICAO Hq.
New Zealand	ICDO Hq.
NAPMO	United Nations
NATO Projects	South Africa
NATO Seasparrow	Uganda
NAMSA-General	United Kingdom
NATO Infrastructure	Upper Volta
NATO Hq.	Uruguay
NAMSA-Hawk	UNTSO (Palestine)
NATO MWDP	Venezuela
NAMFI	
Paraguay	
Peru	
Philippines	
Pakistan	

APPENDIX B

RANDOM SAMPLING COMPUTER PROGRAM

```
PROCEDURE DIVISION.
START.
    OPEN INPUT TAPEIN.
    OPEN OUTPUT TAPEOT.
    SET R-INDX TO 1.
RDHERE.
    ACCEPT INCARD FROM RDR.
    MOVE RAND TO RANDNO (R-INDX).
    SET R-INDX UP BY 1.
    IF R-INDX > 456 GO TO RNDONE.
    GO TO RDHERE.
RNDONE.
    SET C-INDX TO 1.
    PERFORM PICKOFF UNTIL C-INDX = 22.
    GO TO EOJ.
PICKOFF.
    SET R-INDX TO 1.
    PERFORM GETTRANS UNTIL R-INDX = 457.
    SET C-INDX UP BY 1.
    PERFORM RED UNTIL WORK30-32 NOT = SAVE30-32.
    MOVE 1 TO CNT.
    MOVE 0 TO OLDLOCA.
GETTRANS.
    COMPUTE LOCA ROUNDED = RANDNO (R-INDX) * CSIZE (C-INDX).
    ADD .999999 TO LOCA.
    MOVE LOCA TO WHOLELOCA.
    IF WHOLELOCA LESS THAN OLDLOCA OR = OLDLOCA ADD 1 TO
         OLDLOCA MOVE OLDLOCA TO WHOLELOCA.
    PERFORM RED UNTIL CNT = WHOLELOCA.
    MOVE WORK30-32 TO SAVE30-32.
    MOVE WHOLELOCA TO OLDLOCA.
    WRITE OTREC FROM WORKREC.
    ADD 1 TO COUT.
    SET R-INDX UP BY 1.
RED.
    READ TAPEIN INTO WORKREC AT END GO TO EOJ.
    ADD 1 TO CNT CIN.
EOJ.
    CLOSE TAPEIN TAPEOT.
    DISPLAY "0RECORDS READ " CIN UPON PRNTR.
    DISPLAY "0RECORDS WRITTEN " COUT UPON PRNTR.
    STOP RUN.
END PROGRAM.
```

APPENDIX C

ORIGINAL COUNTRY SELECTION AND NUMBER OF OBSERVATIONS

SERVICES	ARMY	NAVY	AIR FORCE
COUNTRIES			
Australia	561	3149	3847
Canada	405	933	3883
Germany	1094	743	2996
South Korea	5360	2219	9986
Spain	1880	1761	1962
Saudi Arabia	3946	1455	3699
Taiwan	4737	7744	10705
Turkey	787	1146	6976

APPENDIX D

FINAL SELECTION OF COUNTRIES AND NUMBER OF OBSERVATIONS

SERVICES	ARMY	NAVY	AIR FORCE
COUNTRIES			
Australia	456	456	456
Germany	456	456	456
South Korea	456	456	456
Spain	456	456	456
Taiwan	456	456	456
Turkey	456	456	456

APPENDIX E

SUBMISSION TIME COMPUTATION COMPUTER PROGRAM

```
PROCEDURE DIVISION.
START.
    OPEN INPUT TAPEIN.
      OPEN OUTPUT TAPEOT.
      MOVE SPACES TO WORKREC.
RDHERE.
    READ TAPEIN AT END GO TO EOJ.
    ADD 1 TO CNT.
    IF ORIG > RECD ADD 365 RECD GIVING WORKDAY ELSE MOVE
        RECD TO WORKDAY.
    SUBTRACT ORIG FROM WORKDAY.
    IF SUBS = 8 PERFORM WRITEOUT.
    PERFORM SETUPCASE.
    GO TO RDHERE.
EOJ.
      PERFORM WRITEOUT.
      CLOSE TAPEIN TAPEOT.
      DISPLAY "0RECORDS READ " CNT UPON PRNTR.
      DISPLAY "0RECORDS WRITTEN " CNTOT UPON PRNTR.
      STOP RUN.
WRITEOUT.
      DISPLAY " " WORKREC UPON PRNTR.
      WRITE OTREC FROM WORKREC.
      ADD 1 TO CNTOT.
      MOVE SPACES TO WORKREC.
      MOVE 0 TO SUBS.
SETUPCASE.
    ADD 1 TO SUBS.
      MOVE WORKDAY TO SUBTIME (SUBS).
      IF COL30 = "B" MOVE 1 TO SERVICE (SUBS).
      IF COL30 = "D" MOVE 2 TO SERVICE (SUBS).
    IF COL30 = "P" MOVE 3 TO SERVICE (SUBS).
    IF COL31-32 = "AT" MOVE 01 TO COUNTRY (SUBS).
    IF COL31-32 = "GY" MOVE 02 TO COUNTRY (SUBS).
    IF COL31-32 = "KS" MOVE 03 TO COUNTRY (SUBS).
    IF COL31-32 = "SP" MOVE 04 TO COUNTRY (SUBS).
    IF COL31-32 = "TK" MOVE 05 TO COUNTRY (SUBS).
    IF COL31-32 = "TW" MOVE 06 TO COUNTRY (SUBS).
END PROGRAM.
```

APPENDIX F

SPSS COMPUTER PROGRAMS FOR ANALYSIS OF SUBMISSION TIMES

```
SPSS.
RUN NAME        FMS DATA FOR ANALYSIS
VARIABLE LIST   COUNTRY,SERVICE,SUBTIME
INPUT MEDIUM    CARD
N OF CASES      8208
INPUT FORMAT    FREEFIELD
VAR LABELS      COUNTRY,SELECTED COUNTRIES/
                SERVICE,ARMED SERVICE/
                SUBTIME,SUBMISSION TIME
VALUE LABELS    COUNTRY (1)AUSTRALIA (2)GERMANY (3)KOREA
                    (4)SPAIN (5)TURKEY (6)TAIWAN/
                SERVICE (1)ARMY (2)AIR FORCE (3)NAVY
COMPUTE         SQTIME=SQRT(SUBTIME)
COMPUTE         SQPLUS=SQRT(SUBTIME)+SQRT(SUBTIME+1)
COMPUTE         LGTIME=LG10(SUBTIME+1)
COMPUTE         RCTIME=1/(SUBTIME+1)
COMPUTE         DUMMY=(10*SERVICE)+COUNTRY
ANOVA           SUBTIME BY COUNTRY (1,6) SERVICE (1,3)
STATISTICS      1
READ INPUT DATA
ANOVA           SQTIME BY COUNTRY (1,6) SERVICE (1,3)
STATISTICS      1
ANOVA           SQPLUS BY COUNTRY(1,6) SERVICE (1,3)
STATISTICS      1
ANOVA           LGTIME BY COUNTRY (1,6) SERVICE (1,3)
STATISTICS      1
ANOVA           RCTIME BY COUNTRY (1,6) SERVICE (1,3)
STATISTICS      1
ONEWAY          SUBTIME,SQTIME,SQPLUS,LGTIME,RCTIME
                     BY DUMMY (1,36)/
                RANGES=LSD(.01)/
                RANGES=DUNCAN(.01)/
STATISTICS      1,3
FINISH
```

APPENDIX G

ACTUAL CELL VARIANCES

SERVICES	ARMY	NAVY	AIR FORCE
COUNTRIES			
Australia	728.79	366.32	136.81
Germany	324.83	89.89	163.33
South Korea	585.64	262.63	84.27
Spain	735.32	86.15	58.89
Taiwan	903.00	305.38	173.43
Turkey	634.20	379.43	134.39

Cochran's C = .1468

APPENDIX H

TRANSFORMED CELL VARIANCES

Transformation Formula: $X^1 = \sqrt{X}$

SERVICES	ARMY	NAVY	AIR FORCE
COUNTRIES			
Australia	5.39	3.19	2.43
Germany	3.07	.68	1.72
South Korea	5.20	2.42	1.46
Spain	5.48	1.02	1.18
Taiwan	5.56	1.79	1.77
Turkey	4.72	3.14	2.59

Cochran's C = .1050

Transformation Formula: $X^1 = \sqrt{X} + \sqrt{X + 1}$

SERVICES	ARMY	NAVY	AIR FORCE
COUNTRIES			
Australia	20.95	12.45	9.06
Germany	11.97	2.68	6.69
South Korea	20.16	9.47	5.35
Spain	21.03	3.91	4.43
Taiwan	21.51	7.38	6.81
Turkey	18.58	12.27	9.86

Cochran's C = .1052

Transformation Formula: $X^1 = \log_{10} (X + 1)$

SERVICES / COUNTRIES	ARMY	NAVY	AIR FORCE
Australia	.15	.10	.18
Germany	.10	.02	.06
South Korea	.19	.07	.11
Spain	.19	.06	.08
Taiwan	.19	.03	.08
Turkey	.09	.10	.14

Cochran's C = .1007

Transformation Formula: $X^1 = \frac{1}{X + 1}$

SERVICES	ARMY	NAVY	AIR FORCE
COUNTRIES			
Australia	.01	.00	.04
Germany	.00	.00	.00
South Korea	.01	.00	.03
Spain	.03	.00	.01
Taiwan	.01	.00	.00
Turkey	.00	.00	.02

Cochran's C = .1967

APPENDIX I

RESULTS OF ANOVA SUBPROGRAM

ANALYSIS OF VARIANCE:

source of variation	sum of squares	degrees of freedom	mean square	F	significance of F
treatment (service)	840362.830	2	420181.415	1229.262	.001
block (country)	524895.282	5	104979.056		
residual	2931162.071	8200	357.459		
total	4296420.183	8207	523.507		

NOTE: There were 8208 observations.

APPENDIX J

MULTIPLE CLASSIFICATION ANALYSIS RESULTS

MULTIPLE CLASSIFICATION ANALYSIS:

GRAND MEAN = 24.38

VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA
COUNTRY			
1 AUSTRALIA	1368	.02	
2 GERMANY	1368	-1.80	
3 KOREA	1368	-4.94	
4 SPAIN	1368	-12.84	
5 TURKEY	1368	9.73	
6 TAIWAN	1368	9.82	
			.35
SERVICE			
1 ARMY	2736	11.12	
2 AIR FORCE	2736	-13.36	
3 NAVY	2736	2.24	
			.44

APPENDIX K

DUNCAN'S MULTIPLE RANGE TEST
HOMOGENEOUS SUBSETS

Subset 1

cell	A/F Korea	A/F Spain	Navy Spain
mean	5.4452	5.8816	8.4539

Subset 2

cell	A/F Spain	Navy Spain	A/F Australia
mean	5.8816	8.4539	8.9364

Subset 3

cell	A/F Germany	A/F Turkey
mean	12.2654	15.1667

Subset 4

cell	A/F Taiwan	Navy Korea	Navy Germany	Army Spain
mean	18.4364	18.5768	20.2522	20.2939

Subset 5

cell	Navy Australia
mean	28.4057

Subset 6

cell	Army Korea	Army Germany	Army Australia
mean	34.2873	35.2368	35.8750

Subset 7

cell	Army Australia	Navy Taiwan
mean	35.8750	38.8421

Subset 8

cell	Navy Taiwan	Army Turkey
mean	38.8421	41.9781

Subset 9

cell	Navy Turkey	Army Taiwan
mean	45.1886	45.3399

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